CLAIMS

We claim:

1. A compact multi-band antenna system comprising:

a main reflector having a shaped surface of revolution about a boresight axis of said antenna and being operable at a plurality of frequency bands spectrally offset from each other;

a multi band feed system for said main reflector comprising a shaped non-linear surface of revolution about said boresight axis of said antenna and a plurality of feed elements;

a first one of said feed elements installed at a first feed element location separated by a first gap from a vertex of said shaped non-linear surface of revolution on said boresight axis of said antenna, said first feed element illuminating said shaped non-linear surface of revolution which defines a ring-shaped focal point about said boresight axis for illuminating said main reflector at a first one of said frequency bands; and

a second one of said feed element installed at a second feed element location separated from said vertex on said boresight axis by a second gap, said second feed element coupled to said shaped non-linear surface of revolution at a second one of said frequency bands to form a single coupled feed, said single coupled feed defining a focal ring for illuminating said main reflector at said second one of said frequency bands.

2. The compact multi-band antenna system according to claim 1 wherein said first feed element is decoupled from said shaped non-linear surface of revolution.

3. The compact multi-band antenna system according to claim 1 wherein said first feed element is further comprised of a feed aperture and said first gap is more than about four wavelengths at a frequency defined within said first one of said frequency bands from said vertex to said feed aperture.

4. The compact multi-band antenna system according to claim 1 wherein said second gap is less than about two wavelengths from said vertex at a frequency defined within said second one of said frequency bands.

5. The compact multi-band antenna system according to claim 1 wherein said main reflector and said shaped non-linear surface of revolution each have no continuous surface portion thereof shaped as a regular conical surface of revolution.

6. The compact multi-band antenna system according to claim 1 wherein said first one of said frequency bands is Ka-band and said second one of said frequency bands is X-band.

7. The compact multi-band antenna system according to claim 1 wherein said shaped non-linear surface of revolution is shaped to form a sub-reflector for said first feed element.

8. The compact multi-band antenna system according to claim 1 wherein said shaped non-linear surface of revolution in said single coupled feed is shaped to perform as a splash plate.

9. The compact multi-band antenna system according to claim 1 wherein a focal ring of said main reflector is about the same diameter as said shaped non-linear surface of revolution.

10. The compact multi-band antenna system according to claim 9 wherein a diameter of said shaped nonlinear surface of revolution has a diameter which is no more than about 150% the diameter of said second feed element.

11. The compact multi-band antenna system according to claim 1 wherein said single coupled feed forms a transition from a circular to radial waveguide.

12. A method for operating a compact multi-band antenna system comprising the steps of:

providing a main reflector having a shaped surface of revolution about a boresight axis of said antenna;

forming a ring-shaped focal point about said boresight axis using a subreflector in the far field relative to a first feed element aligned with said boresight axis; and

positioning a second feed element aligned with said boresight axis in a nearfield position coupled to said sub-reflector to form in combination with said sub-reflector a single coupled feed, said single coupled feed defining a focal ring that transforms a circular waveguide mode into a radial waveguide mode for illuminating said main reflector.

13. The method according to claim 12 further comprising the step of forming said sub-reflector as a shaped non-linear surface of revolution about said boresight axis.

14. The method according to claim 12 further comprising the step of selecting said first feed element to operate within Ka-band and said second feed element to operate within X-band.

15. The method according to claim 12 further comprising the step of selecting said first feed element to have an operating frequency spectrally offset from said second feed element.

16. The method according to claim 12 further comprising the step of concurrently operating said compact multi-band antenna on first and second spectrally offset frequency bands.

17. The method according to claim 16 further comprising the step of positioning an aperture of said first feed element spaced more than about four wavelengths from a vertex of said shaped non-linear surface of revolution at a frequency within said first spectrally offset frequency band.

18. The method according to claim 16 further comprising the step of positioning an aperture of said second feed element spaced less than about two wavelengths from a vertex of said shaped non-linear surface of revolution at a frequency within said second spectrally offset frequency band.

19. The method according to claim 12 further comprising the step of selecting said main reflector and said subreflector to each have no continuous surface portion thereof shaped as a regular conical surface of revolution.

20. The method according to claim 13 further comprising the step of selecting a focal ring of said main reflector to be about the same size as said shaped non-linear surface of revolution.

21. A method for feeding a compact main reflector of an RF antenna on a plurality of spectrally offset frequency bands comprising the steps of:

forming a focal ring for a main reflector by positioning an RF source at a first frequency within said first frequency band positioned in the far field relative to a shaped non-linear surface of revolution so that said shaped non-linear surface of revolution operates as a subreflector;

forming a second focal ring for said main reflector by positioning a second RF source in the nearfield of said shaped non-linear surface of revolution, said second RF source interacting with said shaped non-linear surface of revolution to form a single feed network at said second RF frequency, said single feed network forming a coupled feed focal ring for said main antenna.

22. The method according to claim 21 further comprising the step of transforming with said single feed network a circular waveguide mode of said second RF source to a radial waveguide mode.

23. The method according to claim 21 further comprising the step of positioning said first RF source coaxial with said second RF source.